

***Echinoderes lanceolatus*, a New Kinorhynch from Korea
(Kinorhyncha, Cyclorhagida, Echinoderidae)**

Cheon Young Chang* and Young Hee Song¹

(Department of Biology, College of Natural Sciences, Daegu University, Gyeongsan 712-714, Korea;

¹Department of Biology, College of Natural Sciences, Hanyang University, Seoul 133-791, Korea)

ABSTRACT

A new kinorhynch species belonging to the genus *Echinoderes* is described on the basis of the materials from the subtidal sediments and various macroalgae in the south and east coast of Korea. *Echinoderes lanceolatus* n. sp. is characteristic in having the subcuticular scars in subventral position on segment 3 and incomplete midventral articulation on segment 4, the middorsal spines a little shorter than the corresponding segments, the 'brace-shaped' muscle scars at sternal plates of segments 9 and 10 in females, the flat posterior margin of terminal ventral plates and the lanceolate terminal tergal extension.

Key words: Taxonomy, Kinorhyncha, Cyclorhagida, Echinoderidae, *Echinoderes*, new species, Korea

INTRODUCTION

Since the discovery of a kinorhynch by the French naturalist Felix Dujardin in 1841, which were named after as *Echinoderes dujardinii* Claparède, 1863 (Higgins, 1977a; Pardos *et al.*, 1998), about 140 kinorhynch species belonging to 15 genera of 10 families in two orders have been currently recognized.

Genus *Echinoderes* is the most representative and speciose genus of all kinorhynch genera, and

* To whom correspondence should be addressed.

Tel: 053-850-6454, Fax: 053-850-6459, E-mail: cychang@daegu.ac.kr

54 species are recorded (Adrianov and Malakhov, 1999). So far, total 11 species of *Echinoderes* were reported from the Northwest Pacific, of which five species only had been known as valid by the year of 2001: *E. chefouensis* Lou, 1934 from a Chinese coast of the Yellow Sea; *E. filispinosus* Adrianov, 1989 and *E. multisetosus* Adrianov, 1989 from Russian seas of the East Sea (Peter the Great Bay); *E. koreanus* Adrianov, 1999 and *E. ulsanensis* Adrianov, 1999 from Ulsan at the southeast coast of the Korean Peninsula (see Song and Chang, 2001 for the more detailed history of the kinorhynch research in the East Asia). Quite recently, two new species of *E. sensibilis* and *E. aureus* have been described from Tanabe Bay, southwest Honshu, Japan by Adrianov *et al.* (2002a, b).

This paper deals with the description of the third *Echinoderes* species from South Korea with the discussion of the affinities.

MATERIALS AND METHODS

Materials were obtained from the washings of subtidal bottom sediments and macroalgae at six localities along the south and east coasts of South Korea.

Specimens were filtered in the field through nylon net (67 μ m in pore diameter) after freshwater rinsing for less than a minute for freshwater shock, to be fixed with 5% buffered formalin.

Specimens were mounted in Hoyer's-125 medium (Higgins, 1988) on H-S slide (Shirayama *et al.*, 1993) after placing in a solution of 5% glycerin in 95% ethyl alcohol for 1-2 days, and observed under a differential interference contrast microscope with Nomarski optics. After examination, slides were sealed with nail polish. All drawings and measurements were prepared using a camera lucida.

The detailed method of preparation for scanning electron microscopy was referred to our previous paper (Song and Chang, 2001).

Holotype and allotype have been deposited in the Natural History Museum of Ewha Womans University (EWNHM). Other paratypes are kept in the research collection of the first author.

Terminology and abbreviations used in the text, tables and figure legends mostly follow those of Kristensen and Higgins (1991) and Pardos *et al.* (1998): CS, cuticular scar (glandular pore); MD (6), middorsal spine (of segment 6); LS (7), lateral spine/tubule (of segment 7); LTS, lateral terminal spine; LTAS, lateral terminal accessory spine; MSW, maximum sternal width (on segment 9); SL, sternal length; SW (12), standard width (on segment 12); TL, trunk length excluding terminal spines.

DESCRIPTION

Family Echinoderidae Bütschli, 1876 가시자라목벌레과 (신칭)

Genus *Echinoderes* Claparède, 1863 가시자라목벌레속 (신칭)

***Echinoderes lanceolatus*, new species** 표창자라목벌레 (신칭) (Figs. 1, 2)

Type material. Holotype-Adult female (EWNHM60268), Beomseom (33° 11'53"N, 126° 30'58"E), Jeju I., 3 Mar 2000, J. M. Lee and Y. H. Song. Allotype-adult male (EWNHM60269), Dokdo

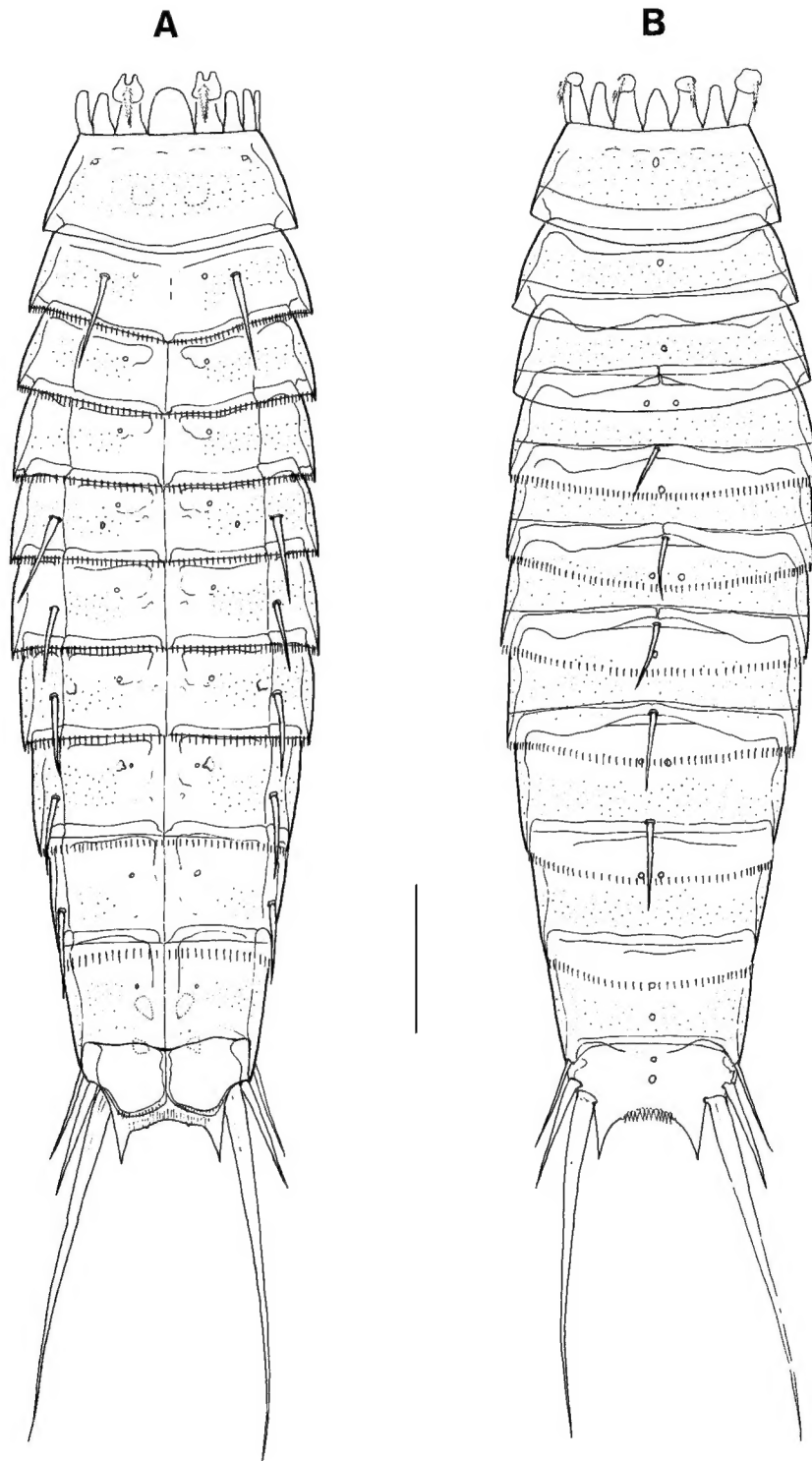


Fig. 1. *Echinoderes lanceolatus* n. sp., female. A, habitus, ventral; B, habitus, dorsal. Scale bar = 50 μm.

I., 12 May 1999, S. K. Paek. Paratypes-5 ♀♀, 2 ♂♂, data as for holotype.

Additional material examined. 1 ♀, Uleung I., 15 Aug 1995, S. H. Kim; 2 ♀♀, 2 ♂♂, Dokdo I., 12 May 1999, S. K. Paek; 1 ♂, Geumodo, 16 Jun 2000, C. Y. Chang, J. M. Lee and Y. H. Song; 1 ♀, Udo, Jeju I., 25 Jun 1997, J. M. Lee and J. W. Choi; 5 ♀♀, 4 ♂♂, Munseom, Jeju I., 26 Feb 1999, J. M. Lee and Y. H. Song.

Diagnosis. Trunk length 266–341 µm, standard width 53.2–60.3 µm, about 17% of trunk length; middorsal spines present on segments 6–10, uniformly increasing in length posteriorly, and a little shorter than the corresponding segments; lateral spines/tubules present on segments 4, 7–12; lateral terminal spines moderately short, about 36% of trunk length; subcuticular scars situated subventrally at segment 3; incomplete midventral articulation present on segment 4; brace-shaped muscle scars present on sternal plates of segments 9 and 10; posterior margin of terminal ventral plates flat; lateral terminal spine moderately short (about 36% of total trunk length).

Description. Trunk length 307.7 µm, MSW-9 (maximal sternal width of segment 9) 65.4 µm, 21.3% of trunk length; SW (standard width = sternal width at segment 12) 52.6 µm, 17.1% of trunk length. Middorsal spines (Figs. 1B, 2D) on segments 6–10 slightly increasing in length posteriorly; lateral spines/tubules (Fig. 1A) on segments 4, 7–12. Perforation sites (base of cuticular hairs) weakly distributed with more or less indefinite pattern. Pectinate fringes of tergal plates not evident on segments 3–4, but becoming apparent on segments 6–8, and rather developed on segments 9–11. Pachycycli well developed, becoming more distinct at ventral midline.

Segment 2 consisting of 16 placids; midventral placid truncate, about 13.4 µm long, much wider than other placids; adjacent ones overlapped anteriorly with prominent trichoscalid plates (Fig. 1A); four alternate dorsal placids each with a smaller trichoplacid (Fig. 1B).

Segment 3 (first trunk segment) representing a complete ring of cuticle, 28.8 µm long. Paired large subcuticular scars present subventrally. A pair of sensory spots situated anterolaterally at sternal plate. Single oval CS located anteromesially at tergal plate. Pectinate fringe not developed at both tergal and sternal plates. Perforation sites apparent on dorsal surface in 4–5 horizontal rows; ventral perforation sites arranged in 3–5 poorly defined rows, diminishing in number laterally.

Segment 4 28.8 µm long. Small incomplete midventral articulation present anteriorly. A pair of LS (= adhesive spines/tubules) present ventrolaterally; LS relatively long (29.5 µm long). A pair of suboval CS situated anteromesially at sternal plate, filled with numerous spinules in concentric arrangement. An oval CS (Fig. 2C) situated anteriorly on the midline of tergal plate. Both dorsal and ventral perforation sites arranged in 3–4 rows. Pectinate fringe present only along posterior margin of sternal plates. Pachycycli well developed, cuticularization extending posteriorly along ventral midline.

Segment 5 23.1 µm long. A pair of CS on either side of midventral cuticularization. One CS situated anteromesially on midline of tergal plate. Pectinate fringe, cuticularization and perforation sites similar to those of segment 4.

Segment 6 22.4 µm long. MD 21.2 µm long, a little shorter than the segment, and slightly beyond posterior setal fringe of the segment. Pectinate fringe of both posterodorsal and posteroventral margin fine and uniform in size. Paired tergal CS located anteriorly on either side of dorsal midline. A pair of sternal CS, cuticularization and perforation sites similar to those of preceding segments.

Segment 7 23.1 µm long. MD 22.4 µm long, a little shorter than the segment. LS (= ventrolate-

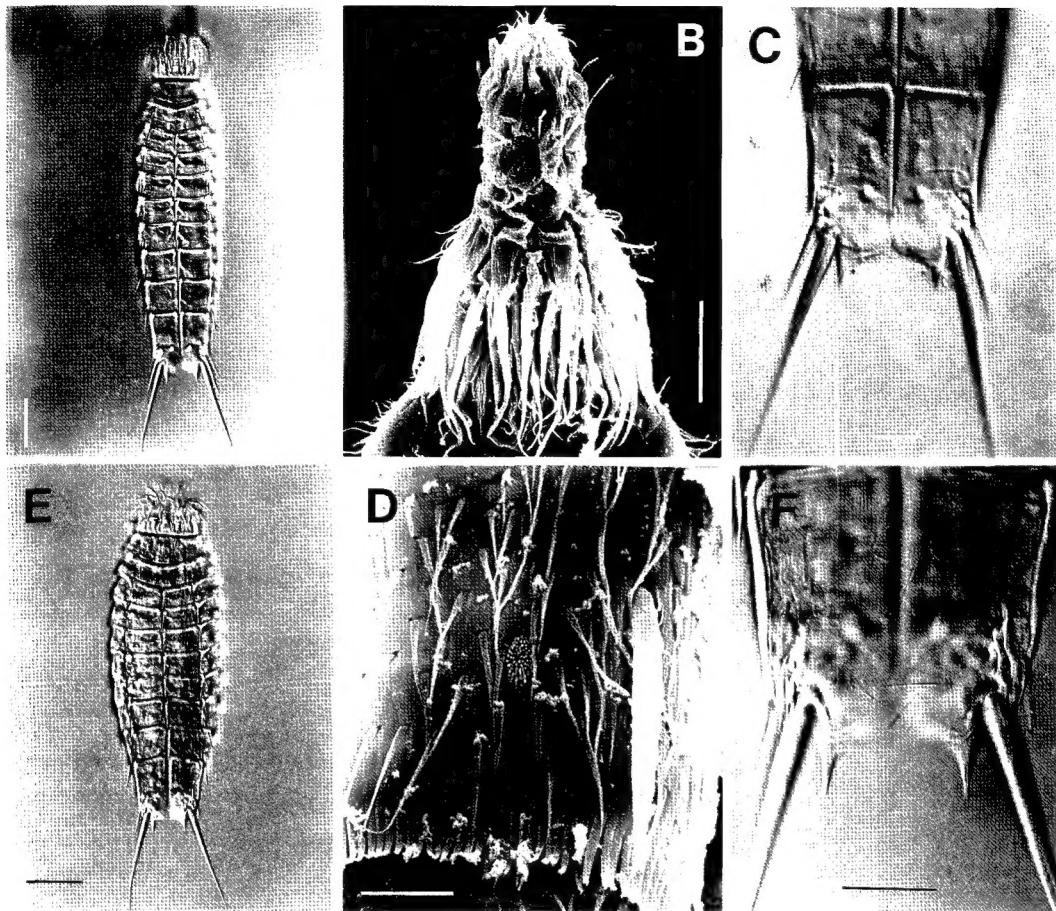


Fig. 2. *Echinoderes lanceolatus* n. sp. A-D, female: A, habitus, ventral; B, oral style and scalids; C, segments 12-13, ventral; D, lateral spine and cuticular scar on segment 7; E-F, male: E, habitus, ventral; F, segments 12-13, ventral. Scale bars = 5 μ m (C), 20 μ m (B, D, F), 50 μ m (A, E).

ral tubules) situated near ventrolateral margin of tergal plate, and extending to middle of next segment, 25.0 μ m long. A pair of small sternal CS on either side of midventral cuticularization, and a pair of oval CS (Fig. 2E) present ventromedially, the latter much bigger than the former. Single, suboval CS situated anteromesially on the midline of tergal plate. Segment otherwise similar to precedent segment.

Segment 8 24.4 μ m long. MD 23.5 μ m long, slightly shorter than the segment. LS relatively short, 17.3 μ m long. A pair of CS situated at both sternal plates and tergal plate as in segment 6.

Segment 9 27.6 μ m long. MD 26.8 μ m long, 97% shorter than the segment. LS 23.1 μ m long. Paired sternal CS located on either side of midventral cuticularization, and a tergal CS located anteriorly on dorsal midline. A pair of 'brace-shaped' muscle scars situated near lateral margin of sternal plate. Segment otherwise similar to precedent segment.

Segment 10 30.8 μ m long, much narrower than the preceding segment. MD 27.6 μ m long, 90

% shorter than the segment, about equal in length with segment 9 and a little longer than MD-9. LS 23.7 μ m long. Paired CS situated both at sternal plate and tergal plate. A pair of 'brace-shaped' muscle scars adjacent laterally to sternal CS.

Segment 11 32.7 μ m long. LS 28.2 μ m long. Middorsal spine absent. Segment much narrowing posteriorly. A pair of CS present both at sternal plates and tergal plate as in the preceding segment.

Segment 12 32.7 μ m long. LS 26.3 μ m long. Pectinate fringe not clear at both posterodorsal and posteroventral margin. Posteromesial part of sternal plates a little protruding. A pair of CS situated longitudinally along midline of tergal plate, as different from those in preceding segments. A pair of large oval-shaped muscle scars present ventrally, either behind the sternal CS. LS situated rather dorsolaterally near posterolateral edge of tergal plate, much longer than other LS, and nearly same in length with LTAS.

A pair of tergal CS on segment 13 arranged as in the preceding segment. CS not apparent at sternal plate. A pair of prominent oval-shaped muscle scars near anterior margin of sternal plate. Tergal extension forming lanceolate furca with nearly smooth mesial margin not interrupted except a blunt, minute projection near base. Terminal tergite not divided at midline, and slightly concave with about 12-13 spinules. Posterior margin of sternal plates nearly flat (neither swollen nor roundish), and lateroposteriorly becoming blunt edge, with numerous terminal setules.

Lateral terminal spines (LTS) moderately short, with smooth outer border; length ratio to total trunk length 35.7%; length ratio of LTAS to LTS 27.4%.

Males showed the sexual dimorphism by lack of lateral terminal accessory spines and the presence of two pairs of penile spines on ventrolateral margin of last segment. Additionally, the brace-shaped muscle scars on sternal plates 9-10, subcuticular scars in subventral position on segment 3, and the incomplete midventral articulation on segment 4 were not apparent in male specimens.

Echinoderes lanceolatus occurred from the washings of shell gravels or coral harshes of subtidal bottom (about 10-27 m deep) and the sea grasses at the lower reaches of rocky shore around Jeju I., east coast and south coast of the Korean Peninsula.

Etymology. The proposed specific name is taken from the Latin *lanceolatus* (spearlike), which refers to the lanceolate shape of tergal extension of this species.

Remarks. This species is allied to seven congeners in sharing the complete set of middorsal spines on segments 6-10 and the general ornamentation pattern of the lateral spines on segments 4, 7-12: *E. ehlersi* Zelinka, 1913, *E. pacificus* Schmidt, 1974, *E. imperforatus* Higgins, 1983, *E. kozloffii* Higgins, 1977, *E. sublicarum* Higgins, 1977, *E. krishnaswamyi* Higgins, 1985, and *E. aureus* Adrianov, Murakami and Shirayama, 2002. However, *E. lanceolatus* n. sp. is clearly differentiated from them by the following character combination: (1) subcuticular scars in subventral position on segment 3; (2) incomplete midventral articulation on segment 4; (3) relative length of middorsal spines (a little shorter than the corresponding segments); (4) brace-shaped muscle scars on the sternal plates of segments 9 and 10; (5) moderately short lateral terminal spine (about 35.7 % of total trunk length); (6) the flat posterior margin of terminal ventral plates; (7) position and number of cuticular spots.

Considering the characters above, *E. lanceolatus* most resembles *E. aureus*, which is the only congener sharing both the subventral cuticular scars on segment 3 and the incomplete midventral

articulation on segment 4 (Adrianov *et al.*, 2002b). However, *E. lanceolatus* shows some clear discrepancies especially in females. Above all, *E. lanceolatus* is evidently distinguished from *E. aureus* by the brace-shaped muscle scars at the sternal plates of segments 9–10. In *E. lanceolatus*, the posterior margin of sternal plates is nearly flat (not swollen nor roundish as in *E. aureus*), and forming a blunt lateroposterior edge. The tergal extension of the present new species is much more sharpened with its mesial margin nearly straight, comparing with that of *E. aureus*. Moreover, *E. lanceolatus* also shows the differences in the arrangement of big muscular scars on the segment 3 and the coloration of body (remarkably yellow in *E. aureus*) (Adrianov, *pers. comm.*).

Echinoderes ehlersi, when referred to the redescription of Higgins and Rao (1979), differs from the new species in having the brace-shaped muscle scars at the sternal plates of segments 8–10 (against at segments 9–10 in *E. lanceolatus*), the much shorter middorsal spines (less than $\frac{1}{2}$ times of the lengths of the corresponding segments, against a little shorter than the corresponding segments in *E. lanceolatus*), the markedly mesially-interrupted tergal extension, and the relatively long lateral terminal spines.

Except for the short lateral spine of segment 12 (about 30–50% of other lateral spines) and the much longer middorsal spine of segment 10 (extending beyond segment 12) in *E. pacificus*, this species is also somewhat similar to *E. lanceolatus*, especially in having the protruding tergal extension and the brace-shaped muscle scars on segments 9 and 10 (Schmidt, 1974).

Echinoderes imperforatus is clearly discriminated from the present new species by lack of the perforation sites as indicated in the specific names, as well as by the brace-shaped muscle scars at segment 8 only (Higgins, 1983).

Echinoderes kozloffii and *E. sublicarum* are easily discernible from *E. lanceolatus* by having the pointed sternal extension. Furthermore, *E. kozloffii* has the much shorter middorsal spines than the

Table 1. Measurements (μm) for adult *Echinoderes lanceolatus* from Korea

Character	N	Range	Mean	SD	Character	N	Range	Mean	SD
TL	16	266–341.7	332.1	20.8	SL3	15	27.6–37.2	32.8	3.8
SW	15	53.2–60.3	56.3	2.0	SL4	15	23.1–31.4	27.7	2.6
MSW	15	62.2–68.6	65.5	2.1	SL5	15	17.3–23.7	21.5	2.0
MD6	14	17.9–26.3	20.8	2.0	SL6	15	20.5–26.3	22.6	1.7
MD7	12	19.2–24.4	22.0	1.6	SL7	15	21.2–32.7	24.5	2.8
MD8	13	22.4–28.2	24.6	1.6	SL8	15	19.9–29.5	25.9	2.3
MD9	15	22.4–30.1	26.1	2.4	SL9	15	21.2–34.0	28.8	3.8
MD10	14	26.9–32.1	29.6	1.6	SL10	15	26.3–33.3	30.2	2.5
LS4	16	25.0–34.0	29.7	3.3	SL11	15	25.6–36.5	33.0	1.5
LS7	14	25.6–33.3	28.5	2.3	SL12	15	34.0–38.5	36.0	1.5
LS8	16	18.6–24.4	21.4	1.7	LTS	13	99.4–121.2	114.1	6.0
LS9	16	19.9–27.6	24.2	2.2	LTAS	11	23.7–40.4	35.3	5.8
LS10	16	25.0–28.8	27.2	1.2	LTS/TL	13	0.33–0.43	0.36	0.026
LS11	16	28.8–31.4	29.0	1.7	MSW/TL	15	0.19–0.24	0.21	0.012
LS12	16	30.1–35.3	32.3	1.8	SW/TL	15	0.17–0.21	0.18	0.011

corresponding segments (Higgins, 1977a). *E. sublicarum* is characteristic in bearing an extremely long middorsal spine of segment 10 (Higgins, 1977b).

Echinoderes krishnaswamyi is apparently distinguished from *E. lanceolatus* by having the denticulate lateral terminal spine and the short tergal extension (Higgins, 1985).

Echinoderes koreanus Adrianov, 1999 and *E. ulsanensis* Adrianov, 1999, which were already known from Korean waters, are not related with this new species in having the different ornamentation pattern of middorsal spines and lateral spines (Adrianov and Malakhov, 1999). Other clear morphological discrepancy between these two species and *E. lanceolatus* lies in the shape of tergal extension (markedly interrupted mesially and not elongated in these species). Moreover, both of them have their own characteristic feature, that is, the subdorsal spiniform setae present on segments 9 and 11 in *E. koreanus*, and the remarkably short and thick lateral terminal spine in *E. ulsanensis*.

ACKNOWLEDGEMENTS

We are most grateful to Dr. A. V. Adrianov for his reading the manuscript with valuable suggestions. We also thank two anonymous reviewers for the helpful comments that greatly improved the manuscript. We are indebted to Dr. S. H. Kim, H. S. Rho, S. K. Paek and J. W. Choi for their support in collecting the materials. This work was supported to C. Y. Chang by grant No. KOSEF 981-0512-058-2 from the Basic Research Program of the Korea Science & Engineering Foundation.

REFERENCES

- Adrianov, A. V. and V. V. Malakhov, 1999. Cephalorhyncha of the world ocean. KMK Scientific Press Ltd., Moscow, pp. 1-328.
- Adrianov, A. V., C. Murakami and Y. Shirayama, 2002a. Taxonomic study of the Kinorhyncha in Japan. III. *Echinoderes sensibilis* n. sp. (Kinorhyncha, Cyclorhagida) from Tanabe Bay. Zoological Science, **19**(4): 463-473.
- Adrianov, A. V., C. Murakami and Y. Shirayama, 2002b. *Echinoderes aureus* n. sp. (Kinorhyncha, Cyclorhagida) from Tanabe Bay (Honshu Island), Japan, with a key to the genus *Echinoderes*. Species Diversity, **7**(1): 47-66.
- Higgins, R. P., 1977a. Redescription of *Echinoderes dujardinii* (Kinorhyncha) with description of closely related species. Smiths. Contr. Zool., **248**: 1-26.
- Higgins, R. P., 1977b. Two new species of *Echinoderes* (Kinorhyncha) from South Carolina. Trans. Amer. Micros. Soc., **96**(3): 340-354.
- Higgins, R. P., 1983. The Atlantic Barrier Reef Ecosystem at Carrie Bow Cay, Belize. II. Kinorhyncha. Smiths. Contr. Mar. Sci., **18**: 1-131.
- Higgins, R. P., 1985. The genus *Echinoderes* (Kinorhyncha, Cyclorhagida) from the English Channel. J. mar. biol. Ass. U. K., **65**: 785-800.

- Higgins R. P., 1988. Kinorhyncha. In: Introduction to the Meiofauna (Eds., R. P. Higgins and H. Thiel). pp. 328-331. Smithsonian Institution Press, Washington, D.C.
- Higgins, R. P. and G. C. Rao, 1979. Kinorhynchs from the Andaman Islands. Zool. J. Linn. Soc., **67**: 75-85.
- Kristensen, R. M. and R. P. Higgins, 1991. Kinorhyncha. In: Microscopic Anatomy of Invertebrates, vol. 4. (Eds., F. W. Harrison and E. E. Ruppert). pp. 377-404. Wiley-Liss, New York.
- Pardos, F., R. P. Higgins and J. Benito, 1998. Two new *Echinoderes* (Kinorhyncha, Cyclorhagida) from Spain, including a reevaluation of kinorhynch taxonomic characters. Zool. Anz., **237**: 195-208.
- Shirayama, Y., T. Kaku, and R. P. Higgins, 1993. Double-slided microscopic observation of meiofauna using an HS-slide. Benthos Research, **44**: 41-44.
- Schmidt, P., 1974. Interstitielle Fauna von Galapagos. 10. Kinorhyncha. Microfauna Meeresbodens., **43**: 1-15.
- Song, Y. H. and C. Y. Chang, 2001. First record of *Campyloderes macquariae* Johnston (Kinorhyncha, Cyclorhagida, Centroderidae) from the North Pacific. Kor. J. Syst. Zool., **17**(2): 207-216.

RECEIVED: 2 May 2002

ACCEPTED: 16 July 2002

동문동물 1신종, 표창자라목벌레 (*Echinoderes lanceolatus*)의 기재
(동문동물문, 원통자라목벌레목, 가시자라목벌레과)

장 천 영 · 송 영 희¹

(대구대학교 자연과학대학 생물학과; ¹한양대학교 자연과학대학 생물학과)

요 약

한국의 동해안과 남해안에서 채집한 동문동물 1신종 (*Echinoderes lanceolatus*)을 기재한다. 표본은 조하대의 저질과 해조류를 플랑크톤 넷트에 걸러 채집하였다. 이 종은 제3마디 흉판 중앙부 양측의 커다란 각흔(殼痕), 제4마디 흉판의 회미한 중앙연접 자국, 각각 해당 몸통 마디보다 약간 짧은 제6-10 정중등가시, 암컷 제9-10마디 흉판의 중팔호형 근흔(筋痕), 마지막 복판의 뒷가장자리가 곧은 점, 그리고 표창처럼 날카롭고 긴 제13마디의 등돌기가 특징이다.